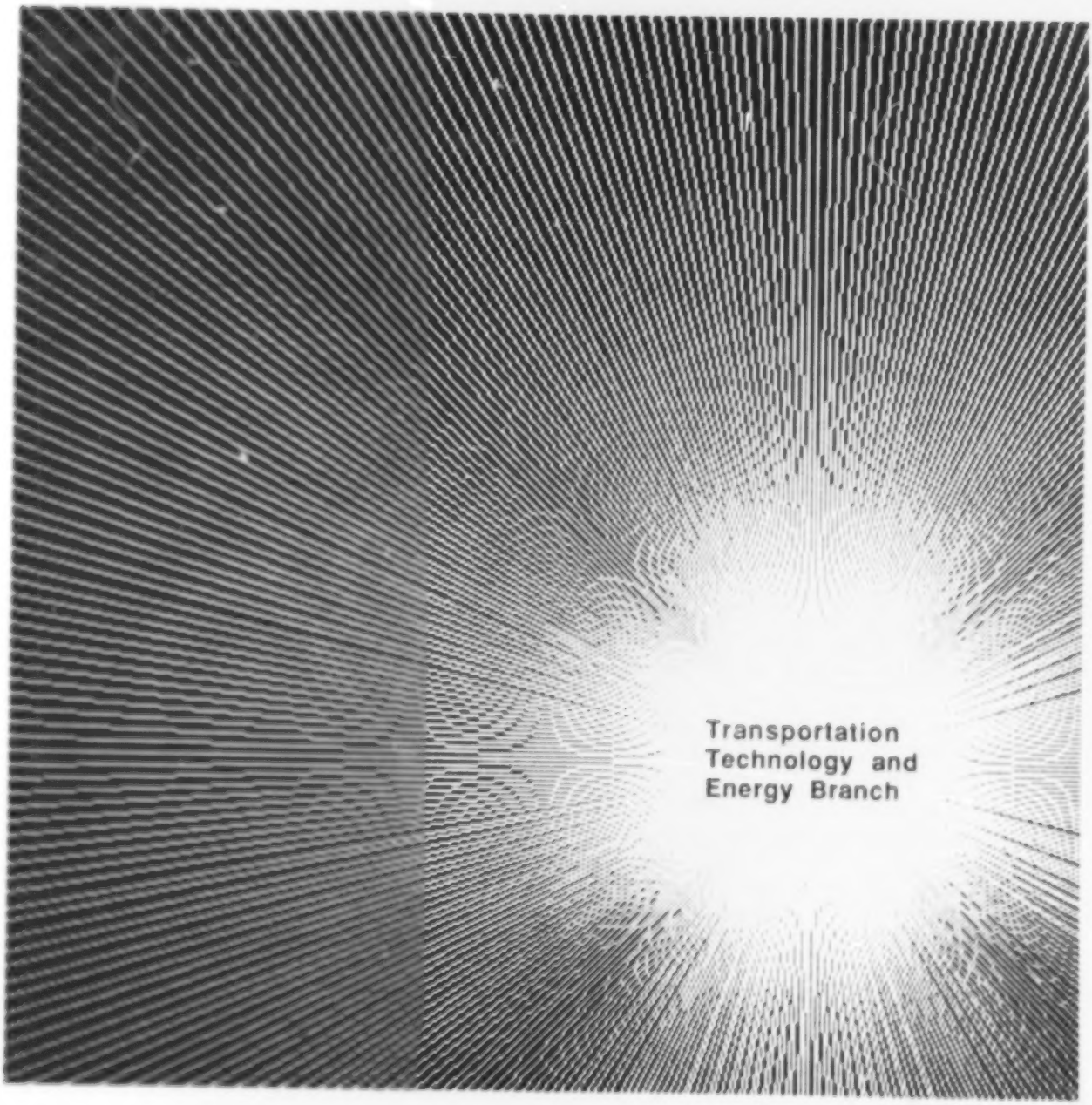
Ontario

Ministry
of
Transportation

Transportation
Technology and
Energy Branch



92-00815/

TravElGuide – Ontario Route Guidance System Concept

TCT-91-03

TCT-91-03

TravElGuide – Ontario Route Guidance System Concept

G. Hetl
Manager
Transportation Control Technology and Systems Office
Transportation Technology and Energy Branch

TAC Annual Conference, September 1991

Published by:
Transportation Technology and Energy Branch
Ontario Ministry of Transportation

Published without prejudice as to the application of the findings. Crown copyright reserved; however, this document may be reproduced for non-commercial use with attribution to the ministry.

For additional copies, write:
The Editor, Technical Publications
Room 321, Central Building
1201 Wilson Avenue
Downsview, Ontario
M3M 1J8
(416) 235-3466

October 1991

ABSTRACT

Automobile drivers are often faced with the need to drive in unfamiliar surroundings, find unknown destinations or select the best route on their travels.

A variety of in-vehicle navigation and route guidance systems have been proposed, developed and demonstrated in the United States, Europe and Japan. Although the systems are certainly useful, sophisticated and attractive, they are also, at least at the moment, relatively expensive.

The Ministry of Transportation of Ontario is actively pursuing the assessment and possible development of TravElGuide, a route guidance system that will offer most of the benefits of more advanced systems but at significantly lower cost.

The present concept of the system includes a portable device that provides advice to the driver, based on real-time traffic information, on the route to take from his current position to his destination. The system does not include an on-board navigation capability; it relies on the driver to act as the navigator, thus resulting in significant cost savings.

This paper provides a brief overview of route guidance systems, describes the TravElGuide concept and compares it against route guidance systems in operation or under development elsewhere.

1/ INTRODUCTION

Advanced Traveller Information Systems (ATIS) is the element of Intelligent Vehicle/ Highway Systems (IVHS) that is garnering the most attention from the transportation community at this initial stage of IVHS development. The reasons are clear. Manufacturers see an early opportunity to commercially produce attractive and viable products. The transportation community sees a useful product that can help reduce traffic delays, minimize miles travelled and at the same time gather vital traffic information that can be applied to improving the general management of traffic.

The media have also found the concept of colour cathode ray tube (CRT) equipped vehicles guiding drivers through the traffic maze that many face today, to be catchy, if not irresistible.

The latest and on-going developments in computers, communications, electronics, vehicle location systems and the accompanying reductions in system costs have resulted in the development, demonstration and indeed, the commercialization of a number of systems in the United States, Europe and Japan.

These systems range from very simple stand-alone route planning programs provided by some car rental agencies to help motorists find their destinations on leaving agency offices, to highly complex in-vehicle systems. These feature two-way communications, colour CRTs, Global Positioning System (GPS) receivers, maps on CD-ROM and talking computers that give drivers detailed directions on how to get anywhere within a metropolitan area.

The Ministry of Transportation of Ontario (MTO) has looked at the range of available systems and their features and developed a concept for TravElGuide, a portable traveller information/guidance system that combines features (offered or proposed by a variety of systems), in a unique way which offers significant benefits to many, at a cost that could be much lower than that of full-scale in-vehicle systems.

A recently completed feasibility study that investigated the technical and economic merits of TravElGuide concluded that the concept warrants further development as it offers a unique combination of features and is likely to find market acceptance.

2/ TRAVELLER INFORMATION SYSTEMS

In the early stages of IVHS deliberations (1990) traveller information systems were thought of as systems and devices to help drivers plan their routes and navigate more efficiently to their destinations.

This definition has recently (1991) been expanded to include all travellers, including transit users, among those who should be able to benefit from access to better information on the state of the road, as well as other transportation systems in their

area. Examples of such systems include: driver route guidance systems that can help a motorist, once in his car, to find the best route to his destination; systems that provide information to the traveller in his home or place of business before the choice of mode or route is made; systems that provide information to transit users on when the next bus will arrive at his stop; and, a range of other travel-related status information that can be an aid to intelligent decision making.

Transportation information may be provided through a number of techniques including television and radio in the home, specialized monitors in malls and offices and special purpose in-vehicle and portable devices offering real-time information as well as guidance to the traveller.

The difficult task faced by transportation officials and system developers is to select the system features which result in the optimum combination of user product and necessary infrastructure to provide the greatest benefit at the lowest cost.

3/ ATIS SYSTEM ELEMENTS

To be useful, a traveller information system needs to provide some of the following capabilities and requires some of the following information. Systems combine these capabilities and information sources in a variety of forms.

3.1/ Route Planning

Route planning means the ability to select an optimal route from one's location to a final destination. The selection may be based on shortest route, quickest route, most scenic route and possibly other criteria. The selection of the route is made prior to the beginning of the trip and, therefore, may be made in the home or office or at some other location outside of the automobile. The simplest of these systems will not take into consideration current traffic conditions, but will be based on normal free flowing traffic. As such simpler systems do not need access to real-time traffic information, they require no communications capability.

Route planning systems may be configured as software packages running on anything from a hand-held computer to a desktop PC. Route planning is an integral feature of more sophisticated route guidance systems.

3.2/ Navigation

The term navigation as adopted by IVHS America's ATIS committee, and used in this paper, simply means the capability to determine one's location. Navigation systems now in use employ one or more of GPS, LORAN-C, roadside beacons and a variety of dead-reckoning systems.

3.3/ Route Guidance

Route guidance involves the provision of assistance to the driver in a detailed step by step manner, on how to get from his current location to his destination. This assistance may be in the form of instructions such as "Turn right at Main Street" or "Turn right at the next intersection." Instructions may be passed on to the driver through verbal instruction, text messages, through the use of symbols or some combination of the above. Route guidance may be combined with navigation, as is the case with most systems under development today, however, route guidance can be achieved without navigation.

Route guidance without navigation can be thought of as an interactive form of route planning. The use of real-time data to calculate the elements of a route is a desirable but optional feature. Route guidance using real-time traffic information but without navigation is the approach adopted in Ontario's TravElGuide system.

3.4/ Map Data Base

Route planning, route guidance and navigation systems require digitized map data bases of differing levels of detail and complexity. Simple route guidance systems may contain the complete road network for a given area without consideration for one-way streets and turn restrictions. The accuracy in terms of distance is not critical.

Navigation systems using some form of dead-reckoning will require distance accuracies of several feet and may need to accurately represent minor geographical features not needed for route guidance systems.

Route guidance systems must contain information about turn restrictions by time of day, as well as one-way streets, bridge heights, where these are restrictive and other information such as truck exclusion zones.

3.5/ Real-Time Travel Link Times

To make route guidance systems responsive to changing travel conditions, up-to-date information on traffic conditions on major routes needs to be supplied to the driver and his system. This information may be limited to such long-term changes as road closures for repairs or more rapidly changing situations such as incidents or accidents.

The most sophisticated and useful route guidance systems will make use of real-time link travel time information. Link travel times are the best estimates of time needed to move from one point in the network to another, taking into consideration actual current driving times. To be effective, link travel time information is required for busier sections of the city including freeways and major arterials. For timeliness, travel time data needs to be updated every few minutes during times of changing traffic conditions. Toronto will require at least 15 000 links for accurate system status representation.

3.6/ Other Traveller Information

If traveller information systems are to serve both drivers and non-drivers, the systems must provide more than automobile travel time information. For transit users, transit schedules, and where available, actual transit vehicle arrival times at stops would be most useful. For those considering the best way to travel on a particular day, a comparison of travel using transit and automobile and possibly other means should be presented. Knowing the time to reach one's destination using one's automobile, sharing a ride and taking an HOV lane or using transit can help the traveller make the best decision to minimize his travel time.

4/ TRAVELGUIDE

TravElGuide is a portable traveller information system that can provide route guidance and route planning assistance to drivers with no navigation capability provided. TravElGuide is a portable computer that incorporates a digital map data base, a radio receiver to collect real-time link travel time information, a graphical and text display capability, route guidance software, synthesized voice to provide directions to the driver and appropriate user interfaces.

The device does not come with or require a navigation capability for operation. The driver acts as the navigator and informs the system of his location and destination at the beginning of a trip. The system then provides step-by-step instructions on the route to be taken to the specified destination. The driver is called upon to recognize specified locations where route changes need to be made.

The system is designed to receive real-time information on traffic conditions, transit arrival times and other useful data over a radio frequency (RF) channel most likely utilizing FM subcarrier. The system does not transmit information back from the vehicle.

As the system does not have a vehicle location capability, vehicles will not act as traffic probes. Traffic data will have to come from other sources. Tests are being prepared to determine if information from the Toronto Transit Commission's Automatic Vehicle Location (AVL) System can be used to provide accurate estimates of automobile travel speeds. As all major arterials in the city are served by transit, arterial link travel times may be obtained from the AVL system.

Toronto is expanding its Freeway Traffic Management System (FTMS). It is anticipated that freeway link travel times can be obtained from the FTMS centre. This set of data will be supplemented where necessary by the use of detector loops or other speed measuring devices.

An interface is provided to the user to communicate with the unit. In a route guidance application the user enters his current location and his destination through the

keyboard. The system returns with a suggested route and step-by-step instructions on the means to get to the destination, such as:

• Turn left at Main Street in 0.3 kilometres.

The user may then prompt the device for the next instruction, ask for a repeat of the same instruction or ask for a new route through activating appropriate buttons, possibly placed on the steering wheel. The device will communicate its instructions on the liquid crystal display (LCD) screen as well as using synthesized voice.

As the system provides no navigational assistance, it will be up to the driver to recognize that he has travelled 0.3 kilometres and that Main Street has been reached. This type of instruction will be found acceptable and useful by most drivers, particularly those generally familiar with their driving environment. Even those in unfamiliar surroundings will be greatly assisted by such instructions which are similar to that provided by human navigators assisting a driver in unfamiliar surroundings.

The system calculates an optimal route based on driver-assigned criteria such as shortest trip, quickest trip or perhaps most scenic trip. The route calculation is based on the latest link travel time information received by the unit from the area's traffic control centre. Experiments indicate that an optimal route calculation can be carried out within a few seconds on a network of ten thousand links.

The map data base will contain all streets within the network and will have all freeways and major arterials included in the route calculation. In order to minimize storage requirements, efficient coding schemes will need to be developed for minor streets and street addresses. Initial studies indicate that the system will not require mass storage devices but will operate using one to two megabytes of solid state memory.
In addition to providing route guidance advice to drivers, the device, since it is portable, could be used to help navigate on foot in strange surroundings. A walking tour covering the sights in a downtown area can easily be envisaged and accomplished.

The system will be realized in the form of a portable palm-top computer that will contain a radio receiver to pick up real-time link travel time information (Figure 1). The device will communicate with the traveller over a graphical LCD and using synthesized voice as the driver advisory during driving.

The chief difference between TravElGuide and most other route guidance systems is the lack of a navigation capability. As this is presently a costly component, TravElGuide will, therefore, be less expensive to produce than other systems, yet provide most of the important capabilities of more sophisticated systems.

Table 1 and Figure 2, taken from the recently completed feasibility study, compare the features of a number of systems currently available or under development. Figure 2

indicates that TravElGuide compares favourably in terms of cost/benefit to other publicly announced systems.

4.1/ Summary of System Capabilities and Features

Capabilities

- Route planning
- Step-by-step route guidance
- Real-time link travel time reception
- Route selection based on user-set criteria
- Display of area map with traffic conditions
- Reception and display of transit information
- Possible use as paging receiver

Features

- Portable, off-the-shelf palm-top computer
- Graphical and text display with keyboard
- Synthesized voice
- Digitized map data base
- Built in RF receiver
- Low cost

5/ SYSTEM STATUS AND FUTURE ACTIVITIES

Today, TravElGuide is a concept. Studies and discussions with others in the profession indicate that the unique combination of features envisioned should make TravElGuide a viable system. In the near future, design activities will begin to build and demonstrate the system in limited quantities.
Discussions have begun with potential private sector partners who are interested in providing the hardware, software, communications and services necessary to make the product a reality. The Ministry of Transportation is pursuing the opportunity to bring the benefits of IVHS to the largest number of people possible at a reasonable cost.

6/ CONCLUSION

Recognizing that new technologies are opening up new opportunities to improve the safety, efficiency and productivity of our transportation systems has brought the potential benefits of IVHS to the forefront of transportation engineering. The enthusiasm of industry, government, media and the public has led to the initiation of a large number of new developments in this field. Traveller information and route guidance systems are being demonstrated in the United States, Europe and Japan. The anticipated cost of many of these systems, however, appears to exceed the price consumers may be willing to pay at this time.

The Ministry of Transportation of Ontario has developed a traveller information and route guidance system concept which offers somewhat limited capabilities but at a significantly reduced cost. The trade-off of features and price appear to place TravElGuide in a favourable position with other announced products.

In the next year, MTO will pursue the development of TravElGuide through a cooperative arrangement with the private sector.

Table 1/ Traveller Information Systems – Comparison

	TRAVTEK	ALI-SCOUT/ AUTO-GUIDE	PATHFINDER	AMTICS	TRAVEL GUIDE	TRAFFIC MASTER
Route Planning	Y	-	-	Y	Y	-
Location/Navigation	Y	Y	Y	Y	-	-
Route Guidance	Y	Y	-	Y	Y	-
Link Travel Times	Y	Y	Y	Y	Y	Freeways Only
Detailed Map	Y	-	Y	Y	Limited	Freeways Only
Other Traveller Info	Y	-	-	-	Y	-
2-way Comm.	Y	Y	Y	-	-	-
Portable	-	-	-	-	Y	Y
Demonstration Site	Orlando	Berlin/ London	Los Angeles	Tokyo, Osaka	Toronto (?)	London

Figure 1/ TravElGuide Unit

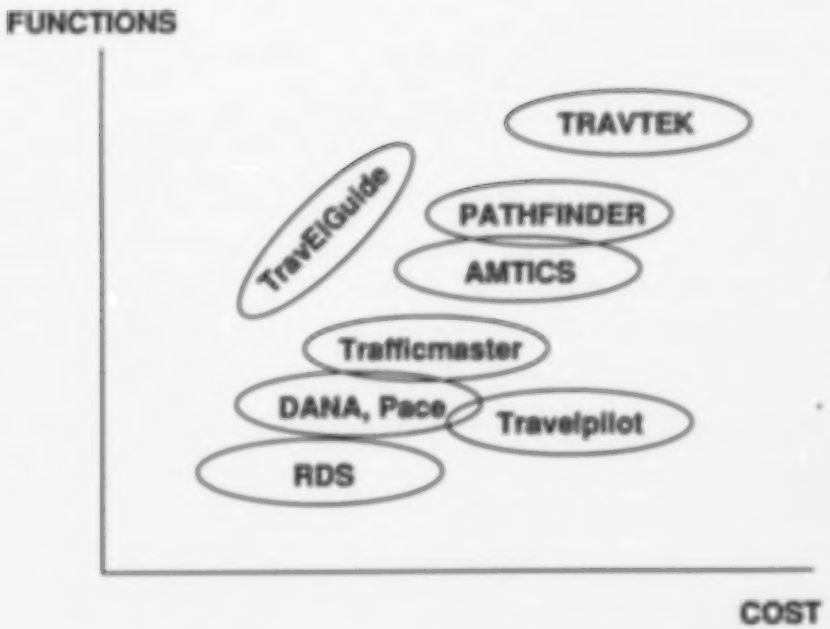


Figure 2/ Cost/Benefit of Existing ATI Systems